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TO WHAT EXTENT SHOULD THE UNIVERSITY INVESTIGATOR BE FREED FROM TEACHING?[1]

THERE can be no single, direct answer to this question. The answer depends on the man; on what he is doing or how he is trying to do it. And if the man be really a capable investigator, he will be most competent to answer this question for himself. There is then no collective problem admitting of a single answer. The important element lies in the premise that the university must foster research as an integral part of its work, for its own sake as an institution, and for the good of humanity. It is research which has made universities possible, and they must provide for the continuance of the succession. Again, teaching without research is not university teaching. In this sense, we must give a broad definition to the word 'research.' Teaching from second-hand sources is never good teaching.

It is the duty of the university to discover, to coordinate and to disseminate truth; and with this, to train scholars and workers, and to develop personality and character. In this many-sided work all members of the university should take some part, but this part in the nature of things must be very unequal; not many men excel in all phases of university usefulness. Some rare men are useful in the highest degree—but in one line only. Around those preeminent in the discovery of truth, chairs of investigation may be built up.

[1] Read before the Seventh Annual Conference of the Association of American Universities, held at San Francisco, Berkeley and Palo Alto, California, March 14–17, 1906.

But the man should always come before the chair. It is futile to frame a chair of investigation, and then to seek a man to fill it. In general, the investigator who can not teach at all is subject to some defect of temper or to some deficiency in health.

As the world goes, with men of our breed, the primary value of research is in relation to teaching. 'The real teacher is the man advancing in some direction' (T. H. Morgan). Many sorts of mental effort go by the name of research, and properly so. These range from first-hand study of well-known problems through all phases of case-counting and hair-splitting—the rearrangement of old material and the description of new—up to competent and courageous excursions into unknown realms of thought and observation. Some may go far and bring back rich returns, some go but a little way and bring back new aspects of old surroundings, but all should go somewhere and bring back something. It is not needful that all departments should adopt the same methods in research. I see no reason why Greek literature, for example, should be treated as though it were a branch of histology, and history need not be stated in terms of chemical reactions. It does not make work scientific to make it hard. All fresh work is desirable, all should be encouraged, though to most men, even university men, only the simpler forms of research can ever be possible. A man of no great talent for scientific pioneering may be an effective teacher, but a man whose grasp of facts and principles is wholly second-hand can never be such. However old his conceptions and however often his thoughts have been expressed, he must derive them afresh from nature if he is to make them vital to others. To the extent that he does so, he is engaged in a form of research. It is his instinct for first-hand contact, the joy in dealing with realities, which is essential to the great teacher, and these traits are primarily those of the investigator also. The instinct for research grows with practise. It is never safe to let it die. Hence the importance of continuity in investigation and the need of it for the teacher at all stages of his development. A man capable of research will do something of it wherever he is and whatever his limitations. In Huxley's phrase, it is 'the breath of his nostrils.' With time and appliances he will do more work and better work, but you may know the real university man by the fact that he does some work which is his own, even under the most untoward conditions. He is safe so long as he is growing. A growing man incites growth, but not even mold will grow on a fossil.

The American university is emphatically a teaching university, to borrow the English distinction of schools that teach from schools that examine. Its professors are teachers. They are not primarily examiners, as in the English universities of all classes, nor do they have the freedom from personal responsibility that is often assumed in the universities of Germany. For the rank and file of our university men, teaching is the main function, and investigation receives its first value from the fact that adequate teaching is impossible without it.

In general, the university professor recognizes his double duty, his actual work as a teacher, and his duty as an investigator to become a better teacher. Some teaching in general aids investigation; it clarifies the mind, broadens the view and saves from vagaries. Teaching and investigation in a general way are mutually helpful—if the combination is not carried too far beyond the fatigue point. This varies with different subjects and with different men. When the two conflict, investigation is likely to suffer. Research can be postponed; teaching can not. Too much teach-

ing breeds brain fag, which kills the joy of knowing and doing. Here again the personal equation comes in, and to a larger degree. Some men do their best work gregariously—directing, controlling and stimulating the interest of others. Some can work well only when alone and undisturbed. Some kinds of work demand uninterrupted attention for a period. Some require special visits to libraries, to museums, or to distant lands. All these matters should receive consideration by university authorities. The plan of giving each year, on full pay, absolute freedom to one or two professors engaged in research, the same privilege later to be extended to others, is one which deserves general adoption. This absence should mean a year for work, not for rest, nor travel, nor for writing text-books. The present sabbatical arrangement will serve for these, but the pursuit of science demands something more than half-pay furloughs. The university authorities should consider these things, and so should the competent worker who must be the final judge of his own work and his own needs.

An obstacle in the way of this and various other forms of relief which inure to the gain of the university lies in the need of personal discrimination, to which governing boards are painfully averse. The mediocre worker is with us, as well as the man who can not investigate at all. A form of senatorial courtesy obtains in all university faculties. Without it, team work, or work as a cooperative body of scholars, would be impossible. But this very fact forms an obstacle to the relief of those men who could make the best use of freedom.

Among young men who have done a little work, there is too much conceit of research, and overmuch desire to secure at once its rewards. Research pays its own way and asks no reward. Moreover, overmuch cackling indicates that eggs are really small and few. Not all who talk of research, even in Germany, shall enter the kingdom. Perfunctory work, work done for the purpose of catching the attention of the easily deceived college president, work done to be heard from, all these count for very little. Freedom from teaching might only increase the quantity, making its badness more visible. This fact the Carnegie Institution has served to make plain, in its dealings with some of our callow doctors of philosophy.

Moreover, the real investigator will follow his own bent. The disposition of our young men 'to paddle in the same pool,' to rush toward each new field where something is proposed, is a symptom of incompetence. There are fads in investigation, and while the fad is on, the product is scanty. In general, all fields of research are open alike, and they have always been open. Each excursion into one of them is rewarded according to its deserts. In this quest single-heartedness and broad-mindedness are the elements which count for most. Cleverness, technique, speed, self-confidence, facility, versatility, perfection of method even—all these are matters of equipment of minor importance. Too often novelty in work is unduly exalted. Much which we call method is only the trick of making a very small discovery appear epoch-making through bolstering of bibliography, philosophy and historical criticism.

In general, the investigator will wish to publish his results. The instinct of the teacher impels him to do this. Yet it is true that publication is a very poor test of research. Some men keep their results for years—for many years—holding them until their conclusions are ripened, their suppositions verified. A voluminous bibliog-

raphy does not necessarily mean contribution to knowledge. It does not even imply originality of thought or breadth of observation. It is quality that counts, and a single fact well tested and set in orderly relation may outweigh volumes of argument or theory. Under the stimulus to get into print, very much is now put forth which university men everywhere feel might be better dropped into the waste-basket. This would be its final fate, printed or not, were it not for the demands of blindly conscientious bibliographers. Some twenty years ago I used these words:

> I am well aware that there is a cant of investigation, as of religion and of all other good things. Germany, for example, is full of young men who set forth to investigate, not because they 'are called to explore truth,' but because research is the popular fad, and inroads into new fields the pre-requisite to promotion. And so they burrow into every corner of science, philology, philosophy, and history, and produce pretty results in as automatic fashion as if they were so many excavating machines. Real investigators are born, not made, and this uninspired digging into old roots and 'Urquellen' bears the same relation to the work of the real investigators that the Latin verses of Rugby and Eton bear to Virgil and Horace. Nevertheless, it is true that no second-hand man was ever a great teacher. I very much doubt if any really great investigator was ever a poor teacher. How could he be so? The very presence of Asa Gray was an inspiration to students of botany for years after he had left the class-room. Such a man leaves the stamp of his greatness on every student who comes within the range of his influence.

University authorities must, therefore, not fear to become respecters of persons. They should give time, freedom, appliances, where these things can be used, while refusing them to the man who would thereby merely advertise his own insignificance.

The valuation of research is, at best, a difficult problem. Much of the results of hard labor would be better left unpublished, and the valuations set by the authors will not be recognized by the workers of the future. Spurious research is worse than nothing. The pressure to print something is responsible for much of it; the leisure of fellowships for much more. Only a few men can make use of leisure. Moreover, leisure without adequate salary avails little. The busy man under the pressure of poverty, edits texts, writes cyclopedias, throws out potboilers of every kind available to his profession. This is not research. It may be respectable, but it does not develop originality nor mark progress.

In the American university of to-day we teach too much, too many hours, too much that is not worth while, too much to people who do not care for this teaching. We teach at too low a tension, with too little enthusiasm, too little inspiration, throwing too little responsibility on the students, showing too great patience with those not worthy to accept responsibility. The men we call professors are paid too little, helped too much in their early preparation, promoted too rapidly and above all with too little discrimination. It would be better for our universities if half our teachers were in some other profession—if the best half were the ones who remained. This will not be the case until our present scale of salaries is advanced. There is too much encouragement of 'digs'—men with technical accuracy but without personal force or originality or skill in interpretation of new material. There is too much toleration of volatile versatility and of the methods of the Sunday supplement. In our profession it is too easy to get into line for promotion, while promotion itself ought to carry more pay, more freedom, and with all this far higher responsibilities than those we now demand.

Some large degree of freedom from teaching should, therefore, be accessible to the investigator, and this freedom can only be stated as a principle not reduced to rule

or set forth in terms of hours or percentages. But as teaching is itself dear to most true investigators, there are other lines of freedom still more important than relief from class work. The work that kills is not teaching, but the routine which goes with teaching. When I accepted my present position, Governor Stanford told me that he thought the president of the university should do nothing he could hire some one else to do just as well. The university professor should be placed in just this position. Everything that can be just as well done by some one else should be taken from his shoulders. He should have a stenographer, a reader, an artist, an artisan, a 'Diener,' all the helpers who can save his time and add to the dignity and strength of his work. A certain amount of executive work, even of committee work, he should be glad to retain—for the American university is a corporation whose affairs need constant vigilance on the part of somebody. In the long run, its greatest scholars are its wisest men, and in their hands its control should finally lie. The highest type of investigation demands many of the qualities which make a man successful as an administrator. Moreover, it would be a pity and a misfortune to have academic management fall into the hands of those not in sympathy with the highest functions of the university itself. It is not the business man, but the man of science, the man of learning, who should direct the internal management of the university. Those who do not understand the scholar's business can not properly direct the scholar's activities. It may be a matter of regret to use our scholars for executive purposes, but it will go hard with scholarship if the scholar loses control. It is surely a mistake to suppose that any scholarly gentleman who becomes a professor can train investigators. It is the master's touch which awakens the latent instincts of the student. Only the university man can create the university atmosphere.

It is not well that even the best of university men should be freed from responsibility for the welfare of the university in all its interests. Leisure without responsibility is dangerous to all save the greatest. This the English universities have demonstrated, though they have not acted on their knowledge. The fellows of Oxford and Cambridge are provided with life-stipends that they may devote themselves freely to teaching or to research. Half of these men are doing nothing even remotely connected with scholarship. With many of them, fox-hunting occupies a higher place than philosophy, and the drink from the Pierian spring is replaced by simpler and more familiar beverages.

Among endowed investigators in Europe, it is no uncommon thing for a man to say, 'It is time for me to produce another paper; research is due this year again.' Then the investigator hunts through the museum or the library for some topic which will yield the maximum of pages with the minimum of labor.

I do not think that men have often succeeded in research unless they have rejoiced in such work, unless it is the spontaneous expression of their natural activities. Such joy in production gives no guarantee that the work shall be good, but it gives the basis on which training can be made effective.

I can not agree with those who regard university professorships for research alone as one of the primary essentials of the American university. We should not divide our men into research professors and teaching professors. It is not good for the universities that among its varied helpers we should recognize distinctions of caste, nor should we try to develop one group of professors as higher than another or apart

from it. Professor N. S. Shaler has well said:

I believe that no teacher should be so burdened with instruction that he can not do inquiry to a reasonable extent. If he accepts the office of teacher he must make that work his principal end. He should understand that inquiry is necessary to fit him for teaching.

I think that the effect would be bad of having certain men set aside as inquirers even for a part of their time. It would tend to increase that already painful division of our instructors into men who are alive and men who are dead. A man should look upon research as he does on traveling—something that, if he is a breadwinner, he has to take by the way. Only a blessed few who have the rare combination of money and purpose can devote themselves to it.

In the same vein, Professor James Perrin Smith observes:

One teaches better by example than precept, and every university professor should be an investigator in the work that he teaches. But routine teaching must be done and the setting aside of a certain number of men as a sort of priesthood to do nothing but research will make the burden of teaching fall more heavily on the less favored ones, some of whom may contain the germs of real contributions to science or literature. In this way both the research and the teaching will tend to become poorer.

Dr. John C. Branner says:

I do not think that every one who is interested in or capable of carrying on investigation has, or should be encouraged to believe that he has, some sort of right to a professional position. Every professor (not emeritus) should be required to give an important part of his time to personal instruction or to the supervision and direction of instruction. At the same time, the professor who is not engaged in research of some kind is not a fit person to be a professor, though he may be a valuable man for giving certain kinds of instruction. Such a person should not be promoted beyond a subordinate position.

My final answer to the question before us is this:

The university should recognize the necessity of research to university men and in a much greater degree than is now the case in any American university. It should provide for this in the way of all needed appliances, material, books, clerical help, artists, assistants, leisure and freedom. These needs can not be enumerated categorically, for they must vary with each individual man. Among them should be named provision from some source to ensure adequate publication. The plan of granting regularly to one or more professors each year a research leave of absence or of freedom from all other duties is especially to be commended. Each competent investigator can be trusted to indicate his own needs; the university authorities need concern themselves only as to his competence and their own ability to respond. Leisure without responsibility serves no useful purpose, and adequate pay is necessary to give fruitfulness to leisure or freedom. Men should not be encouraged to undertake research in order to gain professorships. Rather they should gain professorships in order to make research fruitful. A university need not provide for research fellowships or research professorships. If it possesses the man of a thousand who can be best used by such provision, it can build a chair about him and his needs, this chair to be abolished at once when the incumbency shall cease. We should grant freedom from cheap and sterile activity—from reading papers, sharpening knives and copying letters; from superfluous committee meetings and from routine work any subaltern could do just as well; and, above all, from the thousand makeshifts of poverty. This relief is far more needed than relief from teaching.

Once in a generation [says a correspondent], perhaps appears a man whose work is so important that he should be entirely freed from instruction, and as much as possible from administration; Darwin is an illustration. Otherwise, the importance of bringing the men of first and second rate training and working power into contact with receptive pupils is so great as considerably to outweigh the value of any scientific investigations

they might make if left entirely free from teaching—Agassiz is a case in point. Anton de Bary was one of the ablest investigators of his generation (he died in 1887). But all his brilliant work would sooner or later have been accomplished by, not one person, but a considerable number of other people, and as it lay in the then advanced field involving microscopical appliances and technique, the great improvement in modern methods has enabled inferior men to do some of his work better than he did it, and clear up difficulties he left unsolved. His influence, however, as a teacher can not be overestimated. The men who received inspiration and training in his laboratory are among the leaders, and what is better perhaps, are among the sanest influences in botanical work in their generation. Again the pupils of de Bary's pupils are among the best influences of the younger generation.

In his students the work of a great investigator is multiplied a hundred or a thousand fold. To be thus remembered, to live thus in the spirit and methods of the generations in science that follow after us, this is for us, as university teachers, as university investigators, as men who teach through the method of research, the noblest type of fame, the worthiest conception of personal immortality.

In the preparation of this address I sent a circular note to about a hundred leading university men, and I have received a singularly valuable and suggestive series of answers. Most of them agree in a general way with my own views already stated, or more exactly, their agreement has helped me to form my own final opinions with more precision and more confidence. Some of them state recognized principles with novel force, while a few others hold views unlike my own on one or two phases of the question. A few are partially satisfied with present conditions, believing that these matters are self-regulating and that the universities are doing all that can be done under present conditions. A few again place a higher value on the young enthusiast who thinks that he can investigate what he can not teach, and others still are more tolerant towards the man who can teach what he can not investigate. One correspondent places especial emphasis on the value of leisure, even though for a time our university men may not know how to use it. He says:

I think, in general, that the great lack in the American college and university is lack of leisure. The ideal seems to be that of 'keeping busy' both the faculty and the students. More show of activity is thus made, and trustees are better satisfied. I believe, on the contrary, that a certain amount of guaranteed unoccupied time every day should be a distinctive feature of the academic life, both for student and for professor. Of course, if leisure were suddenly granted, we should neither of us know what to do with it and how to use it rightly. But we can't learn how to use leisure aright without having some little leisure to use. Reform might come gradually. America, it would seem, has combined the English way of keeping its instructors occupied all day with the German idea of extending the working year over three quarters or more of the solar year. But the English tutor gets more than six months of the year to himself; and the German professor lives a much more leisurely life than the American professor can do. The consequence is, I think, that both the Englishman and the German are, at their best, better academic men than we American professors can be.

This leisure I should give to everybody, and I believe that the granting of it would in essentials answer your question. But I add this: I do not think that the number of men capable of doing research work is anything like so great as one would gather from the scientific journals (SCIENCE, for instance), or from the general atmosphere of faculties. The tacking-on of a graduate school to the college and the implicit idea that every holder of a chair can direct if he can not himself accomplish research work, I take to be wrong and mischievous in the extreme. In England, as there are among the students pass-men and class-men, with no jealousy or rivalry or thought of superiority or inferiority, so there are among the teachers men who are appointed mainly to teach and men who are appointed to research offices. I think that this division should be drawn in American faculties. It should be frankly recognized that the majority of professors, however excellent their method of instruction and

however wide their knowledge, are not fitted or expected to carry on original investigation.

Now to the definite answer to your question. If under existing circumstances a man is found who is capable of extended research—one who can attract young graduates to him, give and take fruitful ideas with them, found a 'school' of sound scientific inquiry—then I should think that such a man ought to be highly cherished and privileged; that he should be called upon to set his own amount of teaching work. Some teaching, especially to the very beginners in his subject, he would probably always want to do. But he should, in my opinion, be freed from the intermediate work of imparting information to students in the mid-period of their training. That such a man should be required, day in and day out, to give his best hours to the routine of instruction, has always seemed to me to be a bit of sheer folly on the part of university authorities.

I am obliged to append a postscript. It is useless to grant leisure, whether to all alike or to a favored few, unless an adequate salary goes with it. It is pitiful to see men who are able to do new work spend their summers in summer schools, or devote what scanty time they now have to routine work for the press, for cyclopedias, etc. Even the arrangement of the sabbatical year is really farcical for men who have only their professorial income to rely upon: to take it one must either have 'married money' or have written a successful text-book whose sale adds to one's income. If professors engaged in research were relieved from the work of instruction, with no further change made, I am afraid that they would at once begin—most of them—to devote their leisure time to the acquisition of scholarly appurtenances and various comforts of living: I do not think that the output of research work would, at least for some time, materially increase.

But leisure without responsibility rapidly deteriorates, except with the superior man, to whom all things are possible. The fellowship system of Oxford and Cambridge in hundreds of cases has degenerated to simple graft, with the same evil effect on English education that American forms of parasitism have had on our own local politics. The sinecure and the examination paper are the two burdens borne by higher education in Great Britain—evil influences from which the American university is relatively free, though every land has its own troubles. There is, again, a distinction between instruction in a man's own line of work and the so-called routine teaching of elementary facts to boys without interest in them. The doors of our universities ought to swing more freely both ways, and the student who doesn't care for his own education should find a way out more readily than he does now.

A few of my correspondents emphasize the value of research professorships as corrective of the tendency to regard routine work as the whole function of the university. Without going quite so far as some others, one correspondent has the following suggestive words:

> The burdening sense of accountability under which the American professor suffers is to my mind the real danger point of the situation. * * * It is the advancement, even the rehabilitation of the academic career, that is concerned. To render that career an inviting one for the ablest minds, to give the career the recognition—social, financial; in honor and dignity and general esteem—that it should have to serve the intellectual interests of the nation best, is the larger end in which your special problem finds a place. The present status of the professor lacks much that is desirable and possible; and part of his difficulty lies in the interpretation of his duties, and even more in the emphasis of that portion of his activities for which he is most esteemed, most rewarded. At present I should say that his advance in most institutions depends upon his serviceability to the university on committees and in its general administrative business; and next upon his ability to achieve a certain sort of popularity amongst the students. To subordinate these modes of estimating his services to the far more essential traits that give worth to a man's services, decided influences should be set into action. Among them I should attach high value to any emphasis of the value of research as an integral part of a professor's life work, as one of the preeminent considerations that justify his place in the university faculty. Any such recognition seems to me a decided, and at the moment a much needed, step in advancing the academic career; and for this reason my view upon your special problem takes decided and emphatic shape.

I believe that a large measure of elasticity should enter into the definite assignment of duty, that the minimum requirements should be small. We can not accept either the German, French or English view of the situation. We hold a man to a far more rigorous task, leave less to his decision than do any of these foreign institutions. Our professors are more distinctly engaged to teach. Yet it seems to me so hopeless to look for the career of research in many departments of learning outside of the universities, and its presence in the university is so helpful, that the wiser solution seems to me frankly to include the research program within the larger cultural and practical ends for which universities exist, and thus to afford the professors whose interests lie that way the largest possible relief from teaching, to devote themselves to so integral a part of their function as investigation occupies.

This should apply as well to the younger men. The great point that is made in favor of the German 'Docent' system is that it leaves men free at the most energetic periods of their lives to pursue their own interests. They are accountable to no one; have acquired the privileges of teaching, but no duties other than those voluntarily assumed; they are to work out their careers as freely as they like, and frequently are given the facilities that they need. This again we can not do; but I believe it may stand as an emphasis of the influences that our universities can wisely cherish, though they must use other means to express their esteem of this part of the academic career.

I do not see how the practical side of the issue raised can be met by any formula. Having expressed the trend that seems to me to be worth favoring, the actual determination of ways and means involves a series of practical considerations, often of local considerations, that resist formulation. Taking the provisions that the most enlightened of our universities make for research (and they are considerable), I am willing to venture the opinion that these could be distinctly and liberally enlarged without, in my opinion, rendering the universities open to the charge of overemphasizing this portion of their functions, or of failing to interpret properly the functions of the professor and his duties towards the university from which he obtains his support.

Another correspondent attacks one more phase of our difficulty, the waste of our resources through trying to do too many things. He says:

The chief factor in determining from decade to decade the actual course of study in American universities has been, as I think, the pressure of new subjects for recognition. This pressure changed the pressure of seventy-five years ago, with its slender list of subjects, into the curriculum of forty and twenty-five years ago, whose aim was to compress a bit of each sort of learning into a four years' course. When this became impossible, two courses of study were made and then three. The ground must be covered. No one student could cover the ground, but the catalogue must do so.

The same pressure, growing always greater, caused the so-called all-round course of study to blow up from within, leaving its debris in many new and strange forms of educational practise. * * *

Finally, the same pressure which has caused the multiplication of departments has caused the multiplication of specialties within departments. Science has developed such and such new fields of learning. They demand recognition. They are recognized at such and such institutions. We must recognize them here. We must cover the ground. No student can cover the ground, but the university must do so.

If a university were rich enough to cover the whole ground of learning with first-rate introductory courses on the freshman-sophomore level and then to cover the whole ground again on the junior-senior level, with a vast array of electives, and finally to support research in a correspondingly adequate measure, we might say let it be so; let this limitlessly rich university do by itself what it is really the business of all the universities and learned societies combined to do. It is fine to imagine an institution where every science and every art might be studied upon every level, with no lack of money or of men, or of leisure for the men who do productive work. It is not surprising that this splendid conception, which must be the ideal of the university world as a whole, should be more or less consciously the ideal of particular universities. But in point of fact, the whole university world is not at present rich enough for the full realization of this ideal. And when a single university, even the richest, attempts to do everything on every level, the inevitable failure of the undertaking is sure to appear in some way.

The failure does appear very generally in two well-known ways—first, in the cheapening of the elementary collegiate work; and second, in the restriction of productive research work.

It is said that in the American university there is a necessary internal conflict between the collegiate interests and the university interests. My judgment is that in the larger American universities generally, the greatest enemy of both these interests is the excessive expansion of the course of study.

* * * * * *

There are obviously two ways of cutting down the amount of work which the university shall offer. We may cut down the number of departments, or we may cut down the number of courses offered by the several departments.

The first of these methods is radical. It is a grave matter to abolish a university department—not really more grave, I think, than the establishment of a new department whose justification may be doubtful but for many and obvious reasons a procedure which university authorities must hesitate to adopt. Nevertheless, even such radical pruning may be justified. It can become a question between cutting off some large limbs and the languishing of the whole tree. I shall not be surprised if within the next generation the pressure of circumstances should force the universities to the adoption in a considerable degree of this extreme form of selection.

Meanwhile, we have at hand a much gentler and yet scarcely less efficient method of selection if the departments will cut down the amount and range of work offered by them. Let me put this method of reorganizing and concentrating the course of study in the form of definite proposals. Let there be in each principal university department:

1. A fundamental elementary course.

2. A very strictly limited amount of undergraduate work beyond the introductory course.

3. All the rest of the work offered by the department strictly graduate or research work.

* * * * * *

Without affecting the number of majors or of groups or of departments, we may very decidedly reduce the number of undergraduate courses offered. Here, as I think, is the place for the pruning knife. The universities can cover the whole field of learning in typical introductory courses on the freshman-sophomore level. We can not each of us by any possibility cover the ground on all higher levels. We must select. We must reject, right and left, subjects which have every argument in their favor except that we can not do them all. We must weed out the suckers as a condition of having cornstalks.

There would result apparent hardships for the undergraduate and for some members of the faculty. The undergraduate would not be able, on the one hand, to take a large proportion of his college course within one narrow field, thus becoming a specialist without becoming an educated man; and he would not be able on the other hand to browse far and wide over any and every field which modern learning has developed. He would find instead, however, an abundantly wide choice of majors or of groups each offering an austerely chosen list of representative courses arranged so as to make a substantial center for a college course. And this, whether or not he is to become a specialist, is, I believe, the best thing which the university of to-day can offer him.

I have considered in this connection also the possible hardship to the younger professors who want to have each at least a small amount of advanced work to do. I do not wish to slight this consideration, for it is an essential feature of the university life that the younger men should have the door of hope open. I have not solved this problem to my own satisfaction, but I say this: If an instructor can do important productive work, the university should try to offer him as much leisure as the value of his work appears to warrant, whether he is doing the work with students or alone. What the university can not afford to do is to pay so dearly for elementary, non-productive junior and senior work. These courses are the suckers.

3. Productive work. The freshman-sophomore fundamental courses should be the first gainers from the resources of money and leisure saved by cutting off excessive expansion. The second gainers should be the graduate and research courses. I wish to consider this second gain as it might affect the larger universities and then as it might affect the smaller ones.

(*a*) Our greatest universities are very rich. They have great graduate schools. They have scholars who have proved to be productive men. And yet, when the total output of scholarly work done in them is compared with that done in Germany, for example, the result is generally conceded to be discouraging. In many cases, little is accomplished beyond the comparatively elementary research work which has its terminus in the doctor's degree. No explanation of this result seems so probable as the fact that the German professor has, as a rule, the leisure which the American professor only secures by exception. It is doubtful whether the German rule can or should become the American one while we have the college and the university united in one institution. We wish

our greatest scholar to surrender a little of his time to the freshman. But having asked this of him as a duty of religion, we should spare his leisure as the most precious asset of the university. We should count it a sin to require such a man to 'cover the ground.' We should sacrifice the catalogue, make it thin and full of holes, confine the students to a narrow range of typically good choices, and by these inconsequential sacrifices preserve for the great man his chance to do the work which he alone can do.

(*b*) There is an evil suggestion in the air that a university should not attempt to do advanced graduate and research work unless it is very rich. I know of nothing to justify such a counsel of discouragement. The history of learning, the history of the little universities of Europe, the current history of scholarly work in America, all show that the conditions which permit a man to do productive work may be created anywhere. At the worst, some men in the smaller universities, in the little colleges, and in whatever places may seem more unlikely, will continue to prove that creative work is free for all and is the one thing which can never be controlled by a monopoly. Wherever these men are, they prove also, directly through their pupils or indirectly through their colleagues, the vitalizing effect of research upon teaching, and so demonstrate the true bond of unity between the university and the college. No institutional conditions can wholly suppress these matters of the guild of scholars. It is, however, our main business to organize conditions which shall not tend to repress them, but which shall enable them to give their whole service to society.

In conclusion I will say that the problem of selecting from all the things which might be done the things which shall be done is the most difficult and the most imperative problem confronting the whole school system. It is not an artificial problem. The school must represent civilization. When we have detected and dismissed the fads and frills, there remains the great circle of sciences and arts which will not suffer dismissal and yet for which our long and expensive school system has not yet found enough money nor enough time. This means simply that the school has forced upon it as never before the problem of selecting its course of study.

Some of my correspondents plead for years or half years to be devoted exclusively to research. Others think that research and advanced instruction should go on simultaneously. Still others hold that the elementary student has a special claim on a little of the time of the master. Manifestly these are special cases to be treated each in its own way according to the man and the subject.

In a recent address Professor George H. Nuttall calls attention to the utter inadequateness of the provisions for research in universities or outside, in both England and America. Irrespective of the universities there should be an open career of investigation and in all the various fields of science. Such opportunities exist to a limited degree in our scientific bureaus, surveys and experiment stations, but these should be greatly multiplied, at the same time leaving them open to real talent only.

Says the London *Times:*

In one way or another every branch of research loses promising men, who either go into practical affairs with what knowledge they have or make research itself subservient to money-getting by selling crude inventions, by self-advertisement, or by cooperation with financiers. We have no hierarchy of students on a living wage basis; and as a consequence we are very short of real teachers even for practical purposes. For the real teacher must be an advanced student, not a mere parrot reciting other men's work.

Another correspondent believes in the exclusion of hack work, summer schools and other matters of minor importance which tend to lower the intellectual tone of the university professor. He says:

In cases where a chair is endowed for the expressed object of research, I would go so far as to say that the professor should not only not be required to lecture, but should not even be allowed to lecture, except, if he desires, he might give a course of not more than a dozen lectures confined strictly to an exposition of the subject on which he is engaged in investigating. Such chairs are very few in number, but still there are some. My reason for prohibiting lecturing in such cases is that there is always a temptation in universities for a professor to create a following by appealing to an audience, and the tend-

ency is to lecture more and more, with a loss of time and energy which should be spent on research itself.

Where it is not specified that the professorship is for research, my answer would be that the amount of relief from instruction ought to depend largely upon the qualifications of the professor himself. Some professors who are good lecturers and teachers and valuable as such are not by nature qualified to be investigators, except in a very limited sense. I see no reason why such persons should be relieved from doing what they can do well, on the chance that if relieved from lecturing they might do original work. At the present day there is connected with investigation an idea of superiority over the mere exposition of a subject, and most professors desire to be regarded as investigators. If, however, experience makes it probable that a professor is a good teacher but a poor investigator, I see no reason why he should be relieved of lecturing.

There remains another and a large class of professors, some of whom are good lecturers and teachers, and some of whom are not, but who have a capacity for good, original work, if allowed time for it. It is to this class of students that your question, as I understand it, especially applies. In this case it seems to me that the nature of the subject in which the professor is an expert should be considered. In the more special and technical subjects, those in which the largest additions to the stock of the world's knowledge is to be expected, but where that knowledge, when obtained, is such that it can be absorbed by a comparatively few advanced students, my opinion is that the professor should be allowed at least half of his time—or, better still, more than half of his time—for his own special work, and have the amount of his lecturing and teaching correspondingly reduced.

Other subjects, as, for instance, certain branches of political economy and history, and possibly branches of chemistry, physics and biology, are of such a nature that it may be expected that the results will be of immediate value to a considerable number of students, who, furthermore, should be encouraged to become themselves investigators. In this case it is desirable that the professors should not be so pressed by the work of instructing and lecturing that they have not sufficient time and strength left for individual work in investigation. During the college term, it seems to me that such persons should be allowed at least one third of their time for their own original work, and, what is important, *all* their college vacations.

This last point seems to me to be important, especially in subjects like biology. The tendency is to increase the number of courses in what are called 'summer schools,' as they attract students who increase the total enrollment of a college. I object strongly to having those whose whole time during the college year has been spent in lecturing and in original work, called upon to take classes in a summer school. By all professors who amount to anything the three months of summer vacation are not spent in idleness, but used for original investigation or preparation for the lectures of the year to come.

A correspondent makes the useful suggestion of occasional research professorships to be held for one year. In such appointments, work well under way should have precedence over work contemplated or merely begun. He says:

It seems to me, also, that our great universities would find it a wise policy to have each a small number of highly paid research professorships, which might perhaps not be each for any specific subject, but be assigned from time to time to members of the faculty, somewhat as fellowships are now assigned to superior students. It would add greatly to the attractiveness of university life if professors could feel that there was a chance of having their salaries kept up while for a year or two they were left entirely to devote themselves to investigation.

From others whose views in the main coincide with those of this paper I may quote a few well-put paragraphs.

A correspondent says:

I believe that the professor is, or ought to be, primarily a teacher, and that his first duty is toward his pupils. But I think that mere instruction-giving is the lesser part of his calling. It is teaching by example that best takes root, and it is the leadership into fields of new truth, of the few who have the zeal to enter, that brings the largest and most permanent returns both to the professor and to his institution. The university has a right to expect of the professor that he will give the impress of his personality to both the administration and the teaching of his department. But it has no moral right to demand that he spend all his time and energy in departmental drudgery. To what extent he should be relieved of this in order that he may engage in research will depend on many things—among

others the man, the state of his department, and the stage of his researches, an important work that is nearing completion being more worthy of concessions than one just beginning.

The making of conditions for research is but a just acknowledgment of the debt the universities owe the world of knowledge, and is the first step towards its repayment.

Another says:

Assuming the command of adequate resources, it seems to me that the extent to which professors engaged in research should be relieved from instruction is essentially an individual question, the answer to which is dependent on the relative values of the professor's work in research and in instruction. If the research is of exceptional value, the instruction should be limited to that which relates to the field of research or is tributary to it. Thus much is usually helpful to the research. If on the other hand the instructional work has markedly the higher order of merit, the research work may well be limited to that which is helpful and tributary to the instruction, as a certain amount is assumed always to be. The intermediate cases may well be subjects of special adjustment on lines intermediate between these two, precedence being given to research when it is really productive.

Another says:

Men differ in regard to the relation between research and instruction. The true investigator is born, not made, and will work whether he must teach or not, but the quality and quantity of his work will be directly proportional to the time at his disposal. On the other hand, the investigator who is the product of educational methods is likely to accomplish less as the time at his disposal increases.

The character of the work differs in different cases. Some lines of work require longer absences or longer uninterrupted periods than others.

A man who has demonstrated his ability for research should be able to command a larger proportion of his time for this purpose as he approaches mental maturity.

A distinction should be made between elementary and advanced instruction. Class work with advanced students along lines in which the instructor is personally interested as an investigator is often a great aid to research because it permits contact with other minds, discussion, and the statement in words of thoughts. The mental stimulus involved in this relation between instructor and student is often of great value.

On the other hand, the routine of general or elementary courses, largely attended, where the element of personal contact is mostly absent, often interferes seriously with research.

As the investigator develops he should be more and more free from the routine work connected with instruction.

To sum up: The point of greatest importance is that the investigator should have extended periods of time free from other duties. These should be regarded not as vacation, but as a part of his work. Certain hours in the day or certain days in the week do not meet the needs of the investigator.

Another says:

My experience has convinced me that under the system commonly followed in our universities either the students suffer for lack of attention or research is neglected; and the more eminent the teacher the more surely is this the case. For as a teacher's reputation grows, so does the number of his students increase; and the eminent investigator is forced to either lock himself into his study and neglect his students or devote his days to instruction and restrict his researches to nights, Sundays and vacations, when mind and body are worn out. In no field is it more true than in this that a man can not serve two masters.

I believe that what may be termed the intensive system gives promise of affording relief to what is obviously a very undesirable situation. If the teacher will devote all of his energies for one half of the year to imparting instruction and directing the researches of his advanced students, the students will probably gain more, in most cases, than they do under the present system. And the conscientious teacher will be able to devote the other half year to research without being constantly oppressed with the feeling that he is neglecting students who have sacrificed much in order to gain the opportunity to study with him.

Under the intensive system it would doubtless require a somewhat larger corps of teachers to care for the students than under the present system, where nominally every teacher is available for instruction all of the time. But a professor working under the intensive system would do very much more than half the amount of instruction that he does under the present system; hence the necessary increase in teachers would be less than might appear at first sight.

A correspondent says:

I hold that it is the duty of the university to advance knowledge as well as to supply instruction. So far as possible professors should be permitted to do the work for which they are most competent. If a man is able to advance knowledge to an important extent—there are in fact not many such men—it seems to me that he should be required to give only so much instruction as would be fruitful for his research work. A professor can often do the most for his students by going on with his own work, thus imparting some of his spirit to them.

Another says:

I have always had definite convictions on this subject, which have come in part from personal inclination and in part from a remark you made to me during an impressionable period, in appreciation of a research man in a neighboring institution: 'He manages to use all of his time and energy for his own work.

In every institution there are men who glory in their large classes and the popularity that comes with them, and there are others who would be just as happy in their own work without any students—as long as their salary came regularly. I see nothing inherently wrong in the position of either one of the men, and see no reason why one should look on the other with disdain or the other on the one with envy.

Another says:

In my opinion professors engaged in productive research should meet with every encouragement and assistance from the university authorities. They should be amply provided with the books, the materials and the implements needed in research, and a reasonable portion of their working time should be set free for that purpose. What proportion should be thus set free may not admit of very definite statement, but it would seem that a well-endowed institution should so limit the scope of its work and the consequent amount of instruction offered that its productive scholars could apply at the least one half of their working time in advancing knowledge. It is my opinion that increase of knowledge considered by itself alone should be one of the definite aims of a university. But if this be not granted and the primary function of the university be considered the giving of instruction, it is just as essential that the professors should be investigators. Only those who are themselves engaged in research can lead students beyond the elementary phases of their subjects.

Another says:

I should say that it is at the present time much more important that the general principle of granting time for research be recognized by the universities than that any special fraction of such time be agreed upon. The complexities of the various factors entering in to the particular exigencies or particular cases would in any event make it extremely difficult to settle wisely upon such a fraction and I certainly have no fixed opinion as to the amount which ought to be thus assigned.

Where men are proved capable of profitable research and where institutions are able to make good the loss in the amount of instruction offered, I think a third of a man's time every other year could with great profit to the university be set aside for investigation. In some cases this time would be best invested if scattered over the whole year. In other cases it would be more efficiently spent if concentrated within some given period of three to six months. In certain unusual cases it is undoubtedly judicious to give a larger amount of time than this proposal provides for. Moreover, in some cases research can be carried on with entire success in connection with advanced class work, *e. g.*, certain forms of philological studies. In such instances there is obviously less propriety in setting aside special time for investigation. But as I said at the outset, these complexities are too numerous for me to attempt handling. It will be a great step forward if the principle of recognition of research as an integral part of a first-class instructor's duties can be gained.

Another says:

In general I may say that the instructor who does not investigate is exceedingly likely to get into ruts and will soon become a 'back number.' There is nothing like research to keep one posted on the work done by others. It is a constant incentive to reading. It keeps one posted not only in his special field, but from the interrelationship of problems, it gives him constantly an outlook over what is occurring in other lines.

To what extent the instructor should be relieved from instruction is another matter. If he be entirely relieved, the students of the institution receive practically no benefit from his researches, while he loses all influence over the student. In most cases to allow a professor to devote himself

entirely to research would be a violation of trust funds supporting his chair.

Certainly, in my opinion, every person connected with an educational institution should give some instruction, and I think it would be well if the heads of departments should have some hand in the teaching of at least one elementary class. It would tend to keep at least one foot on the earth.

A correspondent says:

There are many problems of research which require a great deal of time-consuming work in the preparation of material for the study. I believe they ought to have help in the nature of assistants to do a great deal of this kind of work in preparing the material for study and investigation. A professor of horticulture or agriculture is not required to plow his ground, cultivate and harvest his crops. He is given help to do this. He plans the research, oversees perhaps the preparation of the ground and the cultivation and the harvesting, but makes his study from the results of this manual labor which has been done by others. I believe similar help should be given to professors engaged in research in some of the lines of biological work.

Another says:

Regarding the relation of research to instruction, I feel very strongly that no instructor of upper classmen in a university should teach a subject if he has not come to know the values of its elements through testing some of them under new conditions. Even if the instructor be considered apart from his chosen field, simply as an instrument for the stimulation of the thinking power, he is not in a position to teach his subject unless he has some acquaintance with creative work. If I am correct in this view, it would be true that professors engaged in research have also a very important work to perform in instruction.

Another says:

I believe that at least half the time of every professor should be definitely set aside for research, provided said professor has shown the ability and energy to devote this time for such purpose. The enhanced reputation which professors engaged in research enjoy with their students, and the more comprehensive and critical value which it gives to their lectures and other forms of instruction, will more than compensate their institutions for the time set aside for this purpose. It is not men of routine, but men of original ideas, who are the most stimulating to students, and originality can only be generated and kept alive by research. Proof of this is found in the fact that the most inspiring teachers of all time have been investigators. Investigation can not be carried on with the brain fatigued by excessive teaching and excessive hours of administration. In many cases I believe the number of lectures and recitation hours could be substantially reduced with advantage both to the professors and to the students in institutions where owing to limited means a large corps can not be employed.

Another says:

An ideal research position, to my mind, would be one in which there was some teaching, but never enough to endanger the *continuity* of research.

Another says:

I should be very sorry to see our universities making any formal arrangements with their officers looking toward supporting them in research. In my judgment that would divert the universities from their own proper work and would give us a low grade of research. Hitherto research work has been the expression of the spontaneous interest and energy of the searcher, and I look with suspicion on any intrusion of the spirit of working for pay into this field. Yet I can see that in individual instances, where it is known that a man is engaged in an important research, it would be wise to relieve him of some portion of his other daily work. But I should hope such indulgence would never go to the point of making research the subject of contract.

Another says:

The scholarly men make the best teachers. I am not at all sure that the practise of teaching benefits the man of research. This would seem to be the case with the direction of the research of capable graduate students—but elementary teaching may be not only irrelevant to the scholarly interest, but distracting and fatiguing to the point of the exhaustion of energy and the atrophy of interest. I do feel, however, that the man of research is the safest person to whom to intrust the college student. Such a teacher is sure to win and to merit respect, for he measures himself by standards that are objective and intelligible to all.

The teacher who is not a scholar may be a winning and beneficent personality, but he is more likely to be a self-constituted oracle whose

dilettanteism is quite patent to the average undergraduate.

It seems to me clear that no educational system can afford to be dependent upon the chances of genius and temperament, even where these do slightly favor the unscholarly man. But as a matter of fact the chances seem to favor the scholar.

The great academic personalities seem, to my recollection, to have been men who enjoyed the dignity and the straightforwardness of scholars.

I believe therefore, that it is to the advantage of the university to have the same men discover and teach the truth. Professors should not be relieved of instruction, if this is to result in the specialization of the teaching function and the research function.

Furthermore, I do not see any possibility of fairly discriminating between individuals in this respect. The one or the other class (and under present conditions it is bound to be the teaching class, because of the recognition the scholar receives from outside) will be a degraded class, and this I should imagine to be fruitful of discord and jealousy.

I can not see that a moderate amount of instruction can interfere with a man's scholarship, and it is likely to afford him the sort of social service that he needs for his manhood.

I should suppose, then, that it would be wisest to make the required amount of instruction uniform and fix it at a moderate number of hours—say ten per week.

Still another says:

In many cases the complaints of professors that they have not sufficient time for research work, because of the undue amount of instructional work required of them, are not well founded, but are rather due to an inherent incapacity upon the part of the men to do effective research work, which they attribute to the large amount of teaching which they have to accomplish rather than to a natural dislike of hard work.

Another says:

Roughly stated, it is the function of a university to discover and disseminate truth, to train scholars, and to develop character. The relative stress laid upon these competing ends must vary with the conditions surrounding the institution, and in a specific case must be affected by the characteristics of the teacher, of his subject, and of his students, and also by the public opinion in the constituency of the institution and in its faculty and trustees. That public opinion seems to me to be adjusted into rough conformity with what average amount of instruction should be expected from the average teacher, and I should be disposed to regard this as the best basis available, to be deviated from in individual cases as circumstances might indicate.

In my own case, for example, I doubt that it would be wise for Cornell University to leave me more free from duties of instruction, with the deliberate purpose of letting me give more time to research. Such relief would make me less effective, I am convinced, as a teacher, and could be justified only if it was felt that my efficiency in research was greater than my efficiency as a teacher, or else that the need for research in my special field was greater. In some lines of work I believe it might be wise for the institution to provide a small group of junior appointees who might give all their time to research, and to allow ready transfer from the class of junior appointees whose main work was teaching to the class whose sole work was research, and the other way.

Another says:

I am strongly of the opinion that a university which is aiming at the highest ideals of university work should, when it finds men of real and proved capacity for original research of a high order, relieve them as far as possible of educational and administrative drudgery, though there can be no doubt that our universities probably could not afford to do this in the case of a very large number of their professors, nor perhaps would this be desirable. In point of fact, however, men of the type I have in mind are not numerous in any university. I believe that the activity of such men in a university brings in a very rich return through the atmosphere and example which it creates, and it seems to me that the best service of such men to their university lies in their own research work and that of the advanced students who come under their direction and influence.

I believe that such a man, for example, as Balfour did far more for his university in this way than through his lectures and other routine work, but I also think that to remove such men wholly from contact with the students would be a mistake from every point of view. My feeling is that such men should be relieved as far as possible from the drudgery of class work, elementary laboratory instruction, and above all, from administrative detail, for which they are very often unfitted by taste and temperament. I do not have in mind so much the time that is given to

these things, as the diversion of attention in directions wholly foreign to that in which their original work lies, and the destruction of that unconscious cerebration which is one of the most important factors in working out scientific results.

At the same time I fully recognize that a university is also a body of students that must be systematically taught, and I do not think that the work of the effective teacher should be considered as in any way inferior to that of the investigator, nor should professors whose first instinct is that of the teacher, be led to feel that their advancement depends on the accomplishment of original work.

You doubtless know better than I that investigation that is done under pressure of this kind is oftentimes a rather poor pretense. The tendency seems to me to be to differentiate these two types of university professors, and it is probably on the whole a good division of labor.

One thing seems to me quite certain, and that is that our universities will not attain their real aim until they are prepared to give full opportunities for research to men of the first type I have indicated. These are the men who form the real nucleus of the university, and their presence and labors seem to me of more importance from the point of view of real university work than all the rest of our educational machinery put together.

President Woodward, of the Carnegie Institution, says:

The way I put it to myself is this: Can we expect a college professor to do as good work of research for our institution as we might expect from him if he were taken over to the institution and had no work but that of research? Much experience convinces me that work of instruction is very valuable to a man who is pursuing investigation. On the other hand, I find that most men who are pursuing at once work of instruction and investigation in the colleges are giving only the smaller fraction of their time to investigation. Their first duty is toward the institutions with which they are connected, and any man who is efficient as an investigator is also likely to be efficient as an administrator and as a worker on the numerous committees essential to educational institutions. My personal experience and observation would seem to show that here again the work of investigation is commonly given second place.

On one point there is little or no room for doubt, namely, that the work of investigation done by professors and instructors in our American universities has only lately come to be justly appreciated, especially by trustees and regents.

From the point of view of an educational institution, there is likewise another point quite clear to me, namely, that no man can be an instructor of the highest grade without he is also simultaneously at work in some sort of research connected with his work of instruction.

Here I must close my quotations, resisting all temptation to continue. For in fifty other letters I find important considerations pithily stated. But as these all agree more or less distinctly with my own thesis, I must suppress them for the present on the principle adopted some ten centuries ago in burning the library at Alexandria.

SCIENTIFIC BOOKS.

The Dynamics of Living Matter. By JACQUES LOEB. (Columbia University Biological Series, VIII.) New York, The Columbia University Press. 1906. The Macmillan Company, agents.

This interesting book owes its origin to a series of eight lectures delivered by the author at Columbia University in the spring of 1902. The aim of the lectures was to give a presentation of the author's researches on the dynamics of living matter and the views to which they led him. In the present book, however, Loeb gives quite a complete survey of the modern problems of experimental biology, records a great many interesting facts and laws which were recently discovered in this field and discusses them from a broad point of view. The book still retains the division into lectures which are here extended to twelve.

The following quotations from the introductory remarks (lecture I.) inform us of the philosophical attitude of the author towards biological problems. "In these lectures," he says, "we shall consider living organisms as chemical machines, consisting essentially of colloidal material, which possess the peculiarities of automatically developing, preserving, and reproducing themselves." He

says further that we must admit "that nothing contradicts the possibility that the artificial producion of living matter may one day be accomplished. It is the purpose of these lectures to state to what extent we are able to control the phenomena of development, self-preservation and reproduction. * * * We shall only go far enough to satisfy ourselves that no variables are found in the chemical dynamics of living matter which can not be found also in the chemistry of inanimate nature."

In lecture II. the author deals with the general chemistry of life phenomena. Ferments and oxidation are the chief subjects of discussion. The idea of 'catalytic processes between tissues and liquids' was introduced by Berzelius, and Ostwald has shown that catalyzers do not initiate, but only accelerate reactions. The discovery by Crofton Hill and by Kastle and Loevenhart of the reversible action of enzymes is discussed; and also the observations by Neilsen of the reversibility of action by an inorganic catalyzer (platinum black) and that the effects of certain poisons are the same for both organic and inorganic catalyzers. Respiration as a catalytic process is considered. The possibility of two groups of oxidizing catalyzers is suggested: one, of the type of the peroxides, may be present in the protoplasm; and the second, which can act indefinitely as oxidases, may be found in the nucleus. Loeb calls attention to the fact that oxygen not only supplies potential and kinetic energies, but is also important for cell division and growth, and acts as 'protective' agent. Lack of oxygen causes structural changes. Experiments which show the production of CO_2 by enzymes are reported. Concerning the theory of enzyme action Loeb gives a brief statement of the attempt in the stereochemical direction; but he is rather inclined to accept the theory of intermediary reaction. Everything seems to indicate that enzymes form unstable combinations with the bodies whose reactions they accelerate.

In lecture III. under the head of the general physical constitution of living matter are discussed: the limits of divisibility of living matter; Bütschli's views that living protoplasm has the structure of a microscopic emulsion; the colloidal character of living matter; the formation of semipermeable membranes. Loeb gives here the Meyer-Overton theory of anesthesia with which he does not fully agree. "The rapidity of the absorption of narcotics may be due to their solubility in oil, and yet the effect they produce may be due to something entirely different." With regard to the rôle of osmotic pressure and the exchange of liquids between the cell and the surrounding liquid, to the discussion of which a few pages are devoted, it may be mentioned that Loeb says he now believes 'that contractile phenomena inside the cell furnish at least part of the energy of secretion and absorption in those cases where the osmotic forces alone can not explain these phenomena.' In the same lecture an account is given of Loeb's extensive experiments on the antagonistic effects of salts.

In lecture IV. some physical phenomena of life are discussed: the theories of muscular contraction, of protoplasmic motion, of cell division; the origin of radiant energy (phosphorescence) and the electrical phenomena in living organisms.

Lecture V. is on the rôle of electrolytes in the formation and preservation of living matter. Loeb gives here among other things a condensed but clear account of the very extensive and important studies by himself and his pupils on ion-proteid compounds and their relations to contractile tissues. The articles dealing with these subjects are very numerous and scattered in many publications, not all of which are easily accessible. The knowledge of these articles is quite indispensable for a student in general physiology. It is gratifying, therefore, to have an authoritative account of the entire subject presented in only thirty pages.

Lecture VI. deals with the effects of heat and radiant energy upon living matter.

Lectures VII. and VIII. are devoted to a discussion of the different tropisms, to the knowledge of which in the animal world the author has, as is well known, contributed pioneer work.

In lecture IX., on fertilization, the reader will find among other things a lucid account

of the experiments which led up to and established the epoch-making discovery of artificial parthenogenesis.

In lecture X., on heredity, the following subjects are discussed: the hereditary effects of the spermatozoon and eggs; Mendel's important experiments; the mutation theory of de Vries; the determination of sex; the relation of egg structure to heredity; the observations and experiments of Driesch and E. B. Wilson. It does not seem to Loeb 'that a discussion as to the relative influence of protoplasm and nucleus upon heredity will prove very fertile, but that it is necessary to transfer this problem as soon as possible from the field of histology to that of chemistry or physical chemistry.'

Lecture XI. is on regeneration. Here again the author has done a good deal of original investigation and in some parts, as on heteromorphosis and on the influence of the central nervous system, Loeb has done pioneer work. He discusses the subject from the point of view of Sachs's hypothesis of the formation of organs. Loeb here refers the reader to Morgan's writings on regeneration.

In his concluding remarks (lecture XII.) Loeb says among other things: "There is, therefore, no reason to predict that abiogenesis is impossible, and I believe that it can only help science if the younger investigators realize that experimental abiogenesis is the goal of biology. On the other hand, * * * it is not sufficient for this purpose to make proteins synthetically, or to produce in gelatine or other colloidal material round granules which have an external resemblance to living cells."

It is a very interesting book which instructs and at the same time stimulates the reader to independent thinking.

S. J. MELTZER.

ROCKEFELLER INSTITUTE.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for July contains but two articles, 'Adaptive Modifications of Occipital Condyles in Mammalia,' by Charles S. Mead, and 'Living and Fossil Species of Comptonia,' by Edward W. Berry. The former notes the general adaptations of the condyles to permit the movement of the head, the special modifications for carnivorous habits and the arrangement of the condyles in different orders. The second paper is an attempt to work out the relations of such forms as may be referred to *Comptonia,* discusses the succession of forms and includes descriptions of the species admitted by the writer, with their synonymy.

The Museums Journal of Great Britain for June has 'Some Notes on a recent Trip to Greece and the Greek Islands,' by Robert F. Martin, an article on 'National Art Patriotism,' dealing with the purchase of a 'Venus and Cupid' ascribed to Velasquez for £45,000, secured for the National Gallery through the National Art Collections Fund, and an account of the 'New Natural History Museum for Salford.' The organization of the American Museum Association is noticed, and it should be said that the Museums Association of Great Britain cabled its best wishes for the successful inauguration and future progress of the sister society. There is a very considerable instalment of the British Museums Directory, which includes such national institutions as the British Museum, Victoria and Albert Museum and others.

THE leading article in the *Journal of Nervous and Mental Disease* for July is a paper by Dr. Waldemar Heinrich Groszmann on 'The Position of the Atypical Child.' Dr. Groszmann defines his terms very carefully, giving in tabular form a survey of the entire range of child variation. He emphasizes the fact that the atypical condition is a transitive one and tends to become permanent either in the direction of abnormality or of some degree of typicality. He finds it impossible to educate successfully such children in the ordinary public and private schools in conjunction with home environment, and believes that the solution of the problem lies in the institution where the environment can be controlled and adapted to the end in view. Dr. Archibald Church reports a case illustrating the neuritic type of progressive muscular atrophy with a marked heredity, and a second on syringomyelia with involvement of cranial nerves,

probably a syringobulbia. Both these papers are illustrated. Dr. Hugh T. Patrick publishes a brief supplementary report and correction to his paper on 'Hereditary Cerebellar Ataxia' in the March issue of the *Journal* for the year 1902. The meeting of the Boston Society of Psychiatry and Neurology for January 19, 1906, and that of the Chicago Neurological Society for November 23, 1905, are reported.

The first three numbers of the *Philippine Journal of Science* contain several papers which will not appear elsewhere. Among these may be mentioned the completed series on the cocoanut, its growth, the production of oil from the nuts, and the insects attacking the trees, by Messrs. Copeland, Walker and Banks; the monograph on tropical ulcers and the paper on plague vaccination, by Dr. Strong; the preliminary discussion of beriberi, by Dr. Herzog; the first of a series treating of the geology of the Philippine Islands, by W. D. Smith, etc. There have also been published the results of the investigations carried on in Manila by Drs. Brinkerhoff and Tyzzer, but these latter have also been given to the public elsewhere in somewhat different form. The fourth number of the *Journal* will contain the first of a series of articles on the composition of a tropical forest, by H. N. Whitford, the subject being taken up from an ecological standpoint; and the fifth, the beginning of a number of papers on Philippine fibers and fiber substances, with especial reference to their availability for paper making, by George F. Richmond. In June there will also be published seven of the papers read at the third annual meeting of the Philippine Islands Medical Association, one of these being by Professor Kitasato, of Tokyo, on combating plague in Japan, another by Professor Shiga on bacillary dysentery, one by Dr. Strong on questions relating to the aggressins, one by Dr. Stitt on dengue fever, one by Dr. Craig on malaria, and a monograph by Dr. Musgrave on amœbic dysentery and its complications, the subject of liver abscess being especially discussed by the latter.

DISCUSSION AND CORRESPONDENCE.

APPEAL FOR AN AERO-PHYSICAL OBSERVATORY IN JAPAN.

It is well known that the progress of meteorology has seemed very slow. Within the past century the world has seen electricity, chemistry and other special branches of science emerge from their previous uncertain and indefinite condition, but dynamic meteorology is still wandering in fog and darkness. Thousands upon thousands of observations at the earth's surface have told us much, but still the fundamental mechanical problems have not yet been solved. Although the importance of the exploration of the upper atmosphere has been recognized ever since the days of Pascal, yet very little is known of this vast mysterious ocean of air. Meteorologists are now fully convinced that the atmospheric phenomena at the earth's surface depend, in great measure, upon the thermal and electrical, as well as the dynamic, conditions of the upper atmosphere. So long as this upper region remains unexplored, meteorology will not only be unable to enter into the group of exact sciences, but will fail to do its full service for the promotion of human welfare. Hence, a number of mountain observatories have been established in Europe and elsewhere, and many balloon and kite ascensions have been made for sounding the depths of the upper atmosphere. The balloon ascensions of Gay Lussac and Biot in 1804, of Barral and Bex in 1850, of Glaisher in 1862, and of Berson in 1894, furnished many important facts relative to the physics of the atmosphere. Since this last date, unmanned balloons, carrying only very light self-registering apparatus, have been brought to great perfection, and extreme heights of eleven or twelve miles have been reached that would otherwise have been inaccessible. By this mode of research Hermite, Besançon and Teisserenc de Bort in France, and Assmann, Berson and Hergesell in Germany, have done a great service to meteorology. Beginning with October, 1902, daily balloon and kite ascensions were made by Assmann and his associates at the Prussian Aeronautic Observatory, while Teisserenc de

Bort's great work in his famous observatory at Trappes, near Paris, dates back to 1890.

The kite experiments in atmospheric electricity made in America by Benjamin Franklin in 1753, and by Joseph Henry in 1840, are now classic. Most important contributions to meteorology by kite-flying have been made by Messrs. Rotch, Fergusson and Clayton, of Blue Hill Observatory. The United States Weather Bureau in 1898 temporarily maintained seventeen kite stations, and is now completing the Mount Weather Research Observatory, where the temperature, moisture and movement of the air at great heights will be ascertained by means of balloons and kites, while other researches on the sun's heat, atmospheric absorption, atmospheric electricity, terrestrial magnetism and seismic phenomena will be conducted.

In Japan, too, the importance of study of the upper air was recognized soon after the organization of our meteorological service in 1875. Since that time the specialists at the Central Meteorological Observatory at Tokyo and at provincial stations have undertaken many technical expeditions to high mountains in order to investigate the phenomena of the higher strata of the atmosphere. For the establishment of the first Japanese mountain observatory we are indebted to our illustrious Prince Yamashina. For the site of this observatory his imperial highness chose Mount Tsukuba, that remarkable mountain which stands alone on an extensive plain, and which, moreover, lies in the tracks of the cyclones of very intense character. Since its opening in 1902 it has been of great service to observational meteorology in Japan.

It is evident, however, that the atmospheric data observed at mountain stations are very much affected by the local topography and the disturbing elements of the mountain mass and surface. A consideration of the observations made in the free upper air during balloon ascents from Munich, and those made simultaneously at neighboring mountain stations, shows important differences between them. Hence it becomes vitally important for each civilized country or nation to establish on its own soil an aero-physical observatory, like those at Trappes, Blue Hill, Berlin, Lindenberg and Mount Weather.

The scientific problems to be investigated at such a research observatory are manifold, and include the following:

1. The distribution of temperature in the upper atmosphere; the thermal conditions in cyclones and anticyclones; the distribution and condensation of atmospheric moisture; the distribution of pressure in the upper and the lower atmospheres. These are problems of paramount importance, and must be investigated by ascensions of balloons and kites.

2. The absorption of solar heat by the atmosphere, which must be measured by means of the pyrheliometer and actinometer; the dissipation of solar light and heat as determined by the polariscope; the detailed analysis of the sunbeams as carried out by means of the bolometer and spectrometer. To all these there should be added apparatus for studying the conductivity and emissivity of the land and water, the snow fields and the forests of the earth's surface.

3. The discovery of the remarkable properties of radium has opened up a field of research relative to the ionization of gases, and this has led to a complete revolution in our ideas relative to atmospheric electricity. By means of an Exner's electrometer and Benndorf's self-registering apparatus the potential should be measured. To make systematic observations of dissipation and radioactivity of the air under ground we need the Elster and Geitel instruments. Corresponding measurements of the ionization should be made with the Ebert ion-counter, and the Gerdien conductivity apparatus.

Japan feels the direct influences of the Pacific Ocean and the Asiatic continent, and also those of the tropical and polar ocean currents, so that meteorological as well as climatic conditions in Japan are very complex. Very often a continental cyclone, which appears to originate in the Asiatic continent, and a typhoon, which comes from the tropics by way of the Philippines and Formosa, pass over Japan simultaneously, bringing great complexities in the weather. In spite of all these difficulties, however, the storm tracks

and other meteorological conditions have been very carefully investigated by eminent Japanese meteorologists. Japan has just established a new weather service in Korea and Manchuria, and is said to be intending to extend the service to southern China. These are all for immediate practical daily forecasts; but the exploration of the free upper atmosphere by balloons and kites has not been touched. This vast upper ocean of atmosphere, the study of which is exceedingly important for further advances in the physics of the atmosphere, as well as in the prediction of the weather, must remain entirely unknown to Japanese meteorologists until they are able to investigate it.

Japanese meteorologists do not generally possess all the expensive instruments and apparatus that are found in the United States and Europe. In the whole of Japan there is probably not a complete set of modern apparatus for the study of atmospheric electricity, such as those of Elster and Geitel, Ebert, Benndorf or Gerdien. Japanese physicists and meteorologists have relied on their own hands and brains, but we have now come to the age when international cooperation in science is progressing rapidly and our scientists should be provided with laboratories and observatories containing powerful instruments and apparatus. It is sad, indeed, to hear from Japanese meteorologists that they have no hope of establishing an aero-physical observatory similar to those mentioned above.

I have been asked if I can induce some worthy American patron of science or some institution to establish an aero-physical observatory in Japan, or somewhere on the other side of the globe. What we should want at first would not necessarily be a great observatory, such as Mount Weather, but a small one, or several such, where we can observe with kites the conditions of the upper atmosphere, and can also study the atmospheric electrical phenomena by using the Ebert, Elster and Geitel and Benndorf apparatus. Such work is entirely new in Japan, but good physical assistants and materials can be obtained at small cost. It will require comparatively a small sum of money to establish and maintain such an observatory in Japan.

All Americans remember gratefully that the Smithsonian Institution, of Washington, which has done wonderful service for the increase and diffusion of scientific knowledge in America, was founded by a foreigner, an Englishman, James Smithson, in the beginning of the nineteenth century. May not Japan receive similar encouragement from foreign countries or institutions? Scientific research is becoming more and more international and cooperative; it soars far above the differences of race and national policy. The results of the meteorological investigations that are carried on in an aero-physical observatory in Japan will be directly beneficial to the whole human race as well as to that country. The world's meteorology will receive far greater benefits indirectly than will Japan directly. Our atmosphere must be studied as a unit. When the atmospheric conditions in the upper and the lower strata become thoroughly known over America, Europe and Asia, then, and only then, can meteorologists establish the true theories of cyclones, anticyclones, floods and droughts on a firm observational basis. We must remember, however, that at present the atmospheric conditions in the upper atmosphere over the eastern hemisphere of the globe are entirely unknown, and the final solution of our complex aero-physical and dynamical problem is still far away.

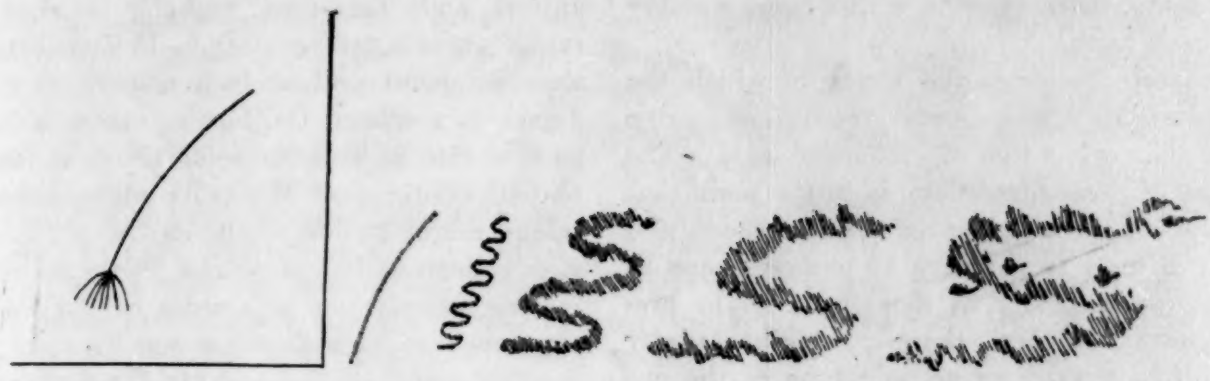
All nations send their naval and merchant vessels to Japanese ports, where we do our best to forewarn them of dangerous storms. A storm-warning service blesses all nations alike. Its signals represent an international cooperation for the benefit of all mankind.

For these reasons I appeal confidently to the American patrons of science for the funds necessary to establish a modern aero-physical observatory in Japan.

S. T. Tamura.

AN UNUSUAL METEOR.

To the Editor of Science: The recent descent of a meteor and its resultant impressed me as being so unusual and interesting that I am prompted to write about it.



At 5:30 P.M., October 13, 1905, shortly after leaving Cortland, N. Y., on a Lehigh Valley train for Elmira, N. Y., I observed to the south or southwest a meteor of great brilliancy. Its first appearance was about thirty degrees from the zenith and descended very rapidly in an arc to about the same distance from the horizon, when it burst like a skyrocket. It left a narrow, smoky trail, which gradually increased in size and changed in form to a zigzag, becoming more cloud-like in appearance and growing fainter and fainter until it was entirely dissipated. The smoky trail in its transition was distinctly visible for ten minutes. The sketches indicate its gradual transition.

E. E. DAVIS.

NORWICH, N. Y.

SPECIAL ARTICLES.

ON THE OCCURRENCE OF DESMOSTYLUS, MARSH.

THE genus *Desmostylus* was described by Marsh[1] in 1888 from tooth fragments found in Alameda County, California. It was referred to the Sirenia, and its nearest affinities were supposed to be with *Metaxytherium* from the Tertiary of Europe. In 1899 and 1900 additional specimens were examined by the writer, with a view to obtaining further information as to its affinities, but no material was obtained which furnished more evidence than the type specimens described by Marsh.

In 1902 Yoshiwara and Iwasiki[2] described from the Miocene of Japan a number of specimens showing tooth structure almost identical with that of *Desmostylus*. This material also furnished considerable evidence concerning the structure of the skull. The authors recognized the resemblances of this form to the Sirenia.

Shortly after the appearance of the paper on the Japanese specimens a review of this article was published by Professor H. F. Osborn,[3] who included a short note on recent studies of *Desmostylus* by Merriam. Professor Osborn considered the reference of the animal somewhat uncertain, very properly pointing out that both sirenian and proboscidean characters were represented.

During the past year two occurrences of *Desmostylus* have come to the notice of the writer. In both cases the reference of the specimens to this form seemed beyond question, and in both instances the occurrence furnished evidence of considerable importance regarding the possible habitat of the animals. The first specimen, consisting of two well-preserved columns of a large *Desmostylus* tooth, came into my hands through the kindness of Professor Andrew C. Lawson. It was obtained by Professor Lawson from Mr. W. L. Still, of La Panza, San Luis Obispo County, Calif. It was found in a cultivated field on Mr. Still's ranch. This locality is stated by Professor Lawson to be in a belt of Monterey shale which extends through this part of the country for many miles.

The second lot of material, including numerous tooth fragments, was presented to the university by Mr. C. H. McCharles, of the University of California. It was obtained from a belt of shale six miles northeast of Santa Ana, Orange County, California, and

[1] *Am. Jour. Sci.*, 1888, p. 94.

[2] *Jour. of the Coll. of Science*, Imperial Univ. of Tokyo, Vol. 16, Art. 6, 1902.

[3] SCIENCE, N. S., Vol. XVI., p. 713.

was found in association with a large number of shark teeth.

In both instances the strata in which the *Desmostylus* remains occur are typical marine deposits, evidently of Miocene age. The fauna of these formations is in the main that of the open sea rather than of the shore, and it is difficult to conceive of proboscideans as occurring typically in these beds. The presumptive evidence, therefore, points pretty definitely toward an aquatic type as the one from which these remains have come.

Of the previously described American specimens we have known very little concerning the occurrence. The only one of which we have any definite information is in the collection of Professor Thomas Condon, of the University of Oregon, who informed me that it was 'picked up on the Yaquina beach, which is throughout marine.' Marsh states that the type specimen was found associated with the remains of a mastodon, a camel, a large edentate, and one or more species of horse, apparently indicating that the deposits were of alluvial or fresh-water origin. Unfortunately, there is no record to indicate exactly where or under what circumstances the material was obtained. The occurrence of the other three specimens from California is also very uncertain.

Influenced by the statement of Marsh, the writer inclined originally to the view that *Desmostylus* was obtained in fresh-water deposits. At the present moment, the only definite evidence fails to lend support to this view. In the case of the Japanese material the evidence is of much the same character as that now available here. It was associated with the teeth of the shark, *Carcharias japonicus*, and with the marine shell *Solen*. Impressions of some land plants were also found, and the authors expressed the view that the deposits, though marine, were of shallow-water origin. Possibly the range extends from marine beds through estuary deposits in both America and Japan.

Although the above notes do not give us very satisfactory information as to the habitat of *Desmostylus*, such evidence as is now before us indicates that this form is an aquatic animal and, therefore, probably a sirenian rather than a proboscidean. If *Desmostylus* were a typical proboscidean distributed from Japan to southern California, one would expect to find it ranging some distance inland on both continents. While its non-appearance inland might be due to our having overlooked it in collecting, its appearance in the marginal marine deposits on both sides of the Pacific suggests that its wide range was over the sea.

John C. Merriam.

QUOTATIONS.

The Faculties in American Universities.

In discussing a paper by Professor Andrew F. West, of Princeton University, presented at the seventh annual conference of the Association of American Universities, President Van Hise, of the University of Wisconsin, said:

> I believe that unity in a university is more important than administrative efficiency, and just so sure as the president and deans and councils are made superior to the faculty the university will lose unity. Indeed, to control general university policies, I believe in a single university faculty which includes every member of the instructional force, so far as participation in debate is concerned, with every person of professorial rank as voting members. To that faculty the various administrative committees should be accountable, and while they may have full power in carrying out settled policies, important variations of policy should be reviewed by the faculty. This proposal of course does not interfere with the power of the faculties of the several colleges to control their own affairs. It seems to me it would be a profound mistake for the president to depend upon his own initiative. If he is not in close fellowship with his faculty, so that they freely come to him with their best suggestions, the institution will make educational progress very slowly indeed. It has been my privilege to receive suggestions freely from the Wisconsin faculty. For my own part, I would sooner see a measure in which I believe not passed, than to have it passed over the faculty. If I can not present the advantages of the measure so that it appeals to their reason, then, in all probability, I am wrong in my educational policy. It may be that in some cases the faculty may be wrong; educational progress might have gone a little faster, had the faculty been overruled; but the grand

average will be much better by the thorough co-operation and harmonious relations which come from mutual respect and mutual acceptance of one another's ideas.

Possibly a president ought to have appeal to a corporation over the faculty. An emergency might arise in which this power might be necessary; but a president will be very wise to use that power rarely. I never have used it, and it would be an extreme case in which I should do so. If a measure were adopted by the faculty of which I thoroughly disapproved, which I could not carry before the trustees with my recommendation, I should ask the faculty to appoint a committee to present that subject to the trustees, so that the faculty should have full representation of their view. I might be obliged to dissent from that view, and then the trustees must exercise their final responsibility.

In conclusion, I think it is important that all the members of the instructional force shall know why a thing is done. If there is a senate above the men, and that senate takes the initiative and passes acts which have been opposed by the faculty as a whole, there is dissension; if, on the other hand, everybody has been given opportunity to express his views fully, then every man feels: "I had my opportunity to express what I had to say; the faculty has voted so and so; that stands as the university action and I will support it." I may be in a somewhat extreme position in regard to this matter; I would have not only perfect liberty upon the part of all our members of a faculty, but I would have unity and concentration of power in a single faculty for general educational policies.

PROFESSOR HENRY A. WARD.

WITHIN a little more than a year two great students of meteorites have passed away. Professor E. Cohen, of Greifswald, who died on April 13, 1905, made studies of the structure and composition of the iron meteorites which marked an important advance in our knowledge of these bodies, and his writings on meteorites in general were monumental in character. Professor Henry A. Ward, who died on July 4, 1906, was the world's greatest collector of meteorites, and made also important contributions to the science of the subject. Both left projected plans incomplete. Professor Cohen's 'Meteoritenkunde' was purposed to be a work of six volumes, of which only three were completed at the time of his death. Professor Ward had practically completed a last great collection, but he had in preparation a large work in three volumes descriptive of the collection and covering the subject of meteorites in general, which was only partially finished. Aside from his work as a collector Professor Ward had made important contributions to our knowledge of meteorites which will always be of value. Perhaps his greatest service, and one which he rendered as no other could, was that of visiting remote corners of the earth to obtain exact and complete knowledge of meteorites whose existence had been hitherto only partially verified. His latest work of this kind was perhaps one of the most important. This was a trip to Santa Rosa, United States of Colombia, to gain exact knowledge regarding an iron meteorite concerning which little was known since the mention of it in 1824 by Boussingault. This trip he had long had in mind and had partially undertaken at other times, but he had not been successful in carrying out his purpose until the present year. He obtained about 300 pounds of this meteorite and full information regarding both it and the adjoining meteorite of Rasgata, which had been much confused with it in literature. It is to be hoped that his notes regarding this meteorite are sufficiently preserved so that a record will be saved to science. Other important meteorites which he 'rescued' in a similar manner were those of Bacubirito in Mexico and Veramin in Persia. The acquisition of the latter meteorite required a visit to the Shah himself, for which Professor Ward's native address and diplomacy served him in good stead. For tasks of this character Professor Ward was fitted as few others ever have been, for his wide knowledge of the world in a geographic sense enabled him to penetrate to the remotest regions and secure exact information. The meteorite catalogues which he has published from time to time have also been peculiarly useful in the accuracy of the locations given, since this accuracy came from a personal knowledge of localities on the part of Professor Ward. This is a service to science which was especially needed, since the

localities of meteorites are an important feature in the determination of their relations, and much confusion has often been caused by efforts to determine whether differently named meteorites belong to single falls. Professor Ward's catalogues will long remain probably the best authority in these matters. Of his last great collection of meteorites, it is enough to say that it contains representatives of more falls than any other collection in the world, and its weight compares well with the largest. The collection thus is, as he desired it should be, the crowning achievement of his life in this direction, and other collectors can bear witness to the fact that he left little ungathered.

Aside from his contributions to science, Professor Ward will long be remembered for his charming personality. The writer's acquaintance with Professor Ward was confined to the later years of his life, but it was a privilege which he highly esteemed. As a *raconteur* Professor Ward had few equals. His many years of travel, his native humor, shrewdness and business sense gave him a wealth of observation and philosophy from which to draw tales that were of the most delightful and instructive character. A letter from Professor Ward, too, was always a delight. Few ever combined more humor and philosophy, shrewdness and science in a single epistle than Professor Ward was accustomed to do, and it is to be hoped that some collection of these writings of his may be made. Professor Ward's knowledge of languages, obtained through years of travel, greatly facilitated his work as a collector. He gained a knowledge of French in his early years through study in Paris, and later travel acquainted him with German, Spanish and several other languages. His knowledge of Spanish was sufficient on a recent visit to Chile to enable him to lecture in that language on the subject of meteorites to the students of the School of Mines in Santiago.

Professor Ward also rendered great service to science in his earlier years through the Natural Science Establishment which he founded. His work in this regard was epochal in creating and developing an interest in natural history museums in this country. The value of the educational influences which he thus set in motion can only be seen in part as yet. While this work bore a more or less commercial aspect, this was by no means Professor Ward's only interest in it, and that he was able throughout his life to serve the cause of pure science was a source of satisfaction to him and fortunate for the world.

Oliver C. Farrington.

FRITZ SCHAUDINN.

The untimely death of Dr. Fritz Schaudinn, at Hamburg on June 22, removes from service one of the most brilliant of the younger generation of biologists, and one who, by careful and conscientious work, has made a name for himself that will endure. Neither an old nor a young man, Schaudinn has, before the age of thirty-five years, done more solid and lasting work of a pioneer nature than any other of his generation, and so wide has been his range of activity that he will be equally missed in the fields of general biology, cytology, zoology and pathology.

Schaudinn's work has been mainly on the unicellular organisms, the protozoa, although he did not confine his investigations to this field. We find his name, for example, in connection with strictly zoological work on Tasdigrades of the Arctic region, and *Ankylostoma* in the mining regions of Westphalia. In another direction we find him bringing his keen observation and power of experimentation to bear upon the problem of bacteria structure, while in general executive work his energy was given to editorial duties in connection with *Das Tierreich* and the *Archiv für Protistenkunde,* of which he was the originator and sole editor.

In the field of pathology Schaudinn has become the foremost and final authority on the disease-causing protozoa. Beginning with the discovery of *Leydenia gemmipara* in the ascites fluid of patients suffering with malignant tumors, he has been one of the most careful and at the same time the most brilliant investigators in this most difficult field of re-

search, and it is not too much to say that Schaudinn's name has been connected with every distinct advance that has been made in protozoan pathology. In his work at the Kaiserlichen Gesundheitsamte on various forms of human disease his experiments were most ingenious and well conceived, while his interpretations were a happy combination of liberality of view and judicious conservatism. While at this post he carried out experiments showing the specific differences between the harmless *Entamœba* (*Amœba*) *coli* and the pernicious *Entamœba histolytica*, the cause of amœbic dysentery. In connection with this institution also, but at the Rovigno Laboratory, he worked out the full life history of *Plasmodium vivax*, the cause of tertian fever, and put the last missing link in the chain of evidence connecting the mosquito with malaria, by watching the penetration of human blood corpuscles by sporozoites taken directly from the mosquito's salivary gland. It was from this laboratory also that he brought out his much-discussed life history of *Trypanosoma noctuæ*, which gave the first light on these important organisms which are so bound up with human affairs in the nagana and surra, etc., of Africa and India, and Trypanosomiasis and sleeping sickness in man. It was while connected with the Berlin institution that he made his last important discovery of *Treponema pallidum*, the cause of syphilis, an organism that has been sought for in vain by biologists and pathologists since the germ theory of disease was established.

It was in the field of general biology, however, that Schaudinn's greatest and most far-reaching work was done. The problems connected with reduction, and maturation in general, and of parthenogenesis, have been illumined by his researches on the life history of protozoa. He was the first to give a complete account of the life history of protozoan organisms, and his work on *Coccidium schubergi* is a model of completeness of detail and of scientific presentation. With it came the stimulus for renewed and more careful observation on protozoa all over the world. With this conception of the life cycle always in mind and its importance in protozoan study always prominent, he studied many different types of protozoa, and in whatever direction he turned the science of protozoology was advanced. The life activities of *Calcituba*, of *Actinophrys*, *Sphærastrum*, *Acanthocystis*, *Paramœba*, were worked out, and the full life histories of *Entamœba*, *Centropyxis*, *Hyalopus*, *Polystomella*, *Trypanosoma noctuæ*, *Spirochæta ziemanni* and *Plasmodium vivax* were established.

In his writings Schaudinn was simple and direct. Nothing was stated for effect, and there is an absolute lack of the polemical spirit in his work, which bears only the fair interpretation of his own work with never a thought of priority or of personal advertisement. His experimental work was conceived and executed with a rare combination of skill and patience, and in its very simplicity of statement his writing had the merit of carrying conviction, so that what he has done will remain as landmarks in the field of protozoan research.

GARY N. CALKINS.

THE ROYAL BOTANIC SOCIETY OF LONDON.[1]

THE great revival in gardening which has been taking place during the last few years has not had such a beneficent effect on the Royal Botanic as on other kindred societies. Instead of increasing its membership by leaps and bounds and thus improving its financial position, it has found expansion impossible and new enterprise checked by lack of funds. The question as to whether any of the conditions in its constitution and methods are at fault has been under discussion for some months. A committee of conference of fellows was appointed and a report (or rather two, as there was a minority one also) has been presented to the council suggesting various possible reforms. These have been under the consideration of the council, who have just issued their reply. It is evident that, although there is willingness to meet the fellows' wishes on several points, none of the sweeping changes advocated will be adopted; and it seems doubtful to those outside the society who are competent to judge whether the few changes will

[1] The London *Times*.

be sufficient to meet the present difficulties. The idea of admitting a certain number of fellows without the payment of entrance fees has not been accepted, on the ground that 350 would have to be elected to bring in the same sum as 100 who paid the entrance fee. So this apparently simple inducement to get new members is to be put aside. Whether they continue to join at all with the five guineas entrance and two guineas annual subscription remains to be seen. It is clear, however, that the same sum will give more privileges in most horticultural societies. It has been suggested that the transactions of the society should be brought out in a more pretentious form, and the council certainly seems wise in rejecting this proposal at present, which is only likely to increase the expenses of the society without adequate compensation. Whether the plan of admitting nurserymen to the gardens and giving them space for growing the plants they offer for sale is the best way of insuring an improvement in the gardens may be open to question, but there is much to be said for the plan; and the plots need not occupy all the available space: anyhow this, too, is rejected. But no alternative alteration is contemplated by the council, who appeal to the opinion of four trustworthy experts, who have reported on the condition of the gardens. From the point of view of good gardeners they have no fault to find; the upkeep of both the open ground and the greenhouses reflects credit on the staff.

But what strikes the outsider is that in this age of progress in horticulture, when people are constantly getting new ideas and studying fresh combinations, there are no opportunities to learn at the botanic gardens. There is nothing to stimulate, nothing to inspire. The gardens are not better than the park outside; so the inducements to become a fellow are few, although the club-room and library are a valuable addition. Even at the shows many people feel there will not be so much that is novel, and the keenest horticulturists do not go, and the nurserymen, who admit that they are given every facility, and that every consideration is shown them, and they have more room for display, yet take far fewer orders in three days there than they do in one elsewhere. The fact is, the gardens, although charming in many ways, are not up to date, and complacent satisfaction in their present fitness will not mend matters.

It is strange also that lectures should not have been well attended. Those given on botanical subjects at the Chelsea Physic Garden, which is not in a much more central position, had an average attendance of seventy, which shows there is room for work in this direction.

It will be a great loss to science if this important society, once the leading one, forfeits its high position by not pursuing a more forward policy at this critical moment in its history.

THE INTERNATIONAL INSTITUTE OF SOCIOLOGY.

The Institut International de Sociologie was organized in 1893, with headquarters in Paris, where its congresses have hitherto been held. Its first president was Lord Avebury, the present president of the Sociological Society. From the beginning, its international character has been maintained. Its membership has included Professors Kovalewsky and Novicow for Russia; Brentano, Bücher, Conrad, Schmoller, Schaeffle, Simmel and Wagner for Germany; Gumplowicz and Menger for Austria; Baldwin, Giddings, Small and Ward for America; and, besides Lord Avebury, Professors Foxwell, Nicholson, Tylor, Sidgwick and Mr. Frederic Harrison for Great Britain.

The present congress came to London through the joint invitation of the Sociological Society and the University of London. All of the sessions were held in the Jehanghir Hall of the University Building, South Kensington.

After the closing meeting, excursions to Oxford and Cambridge took place, which, it was hoped, could be arranged as motor car excursions. A visit to Edinburgh and Glasgow was planned to take place some time during the week following the congress.

The provisional program was as follows:

Tuesday, July 3, at 4 P.M.—General opening meeting. Addresses by the president of the institute, the president of the Sociological Society, and a representative of the University of London. Report of the secretary-general.

8:30 P.M.—Conversazione given by the University of London.

Wednesday, July 4, at 10:30 A.M.—'Caractères généraux des luttes sociales': M. J. Novicow, Professor Lester Ward, Professor Ludwig Gumplowicz, Dr. Raoul de la Grasserie, M. S. Halpérine.

3:30 P.M.—Garden party given by Lord Avebury.

Thursday, July 5, at 10:30 A.M.—Suite du débat.—'Les luttes sociales d'après Herbert Spencer': Professor Ludwig Stein. 'La guerre est-elle un facteur nécessaire?': Professor A. D. Xénopol.

2.30 P.M.—'Luttes sociales dérivées des problèmes industriels en Angleterre': M. Frederic Harrison. 'La lutte pour le travail, et les inemployés': Professor Loch. 'Etude comparée des luttes sociales contemporaines dans les principaux pays occidentaux, y compris l'Amérique du Nord': Dr. Emil Reich.

8 P.M.—Banquet given by the Sociological Society.

Friday, July 6, at 10:30 A.M.—'La sociologie des partis politiques': Professor Lester Ward. 'L'évolution politique de l'Italie': Senator Professor G. Arcoleo. 'La foule et les meneurs': M. K. J. Kochanowski. 'Les luttes intermentales': M. Emile Frey.

2:30 P.M.—Closing meeting.

RESULTS OF THE GERMAN CENSUS.

THE results of the German census, which was taken on December 1, last, represent the total population of the home empire as 60,605,183 persons, an increase of over 47 per cent. since 1871, and of 7.52 per cent. since the census of 1900. A study of the distribution of the increase among the various parts of the empire shows that Prussia, with nearly two thirds (37,278,820) of the total population, has grown at a greater rate than the rest of Germany, the increase in the number of its inhabitants during the past five years being 8.14 per cent. Growth has been most rapid in the three western provinces in the valley of the middle Rhine—Westphalia (13.50 per cent.), Rhineland (11.74 per cent.), and Hesse-Nassau (9.07 per cent.)—which, with an area of less than one fifth of that of Prussia, contains nearly one third (12,124,052) of its population. In the county (Regierungs-Bezirke) of Potsdam there has been an exceptionally rapid increase in the population the number of inhabitants being returned as 2,327,853, or 20.66 per cent. more than in 1900. The city of Berlin, the population of which is enumerated separately, had last December 2,040,222 inhabitants, an increase of 8.01 per cent. In no province or county of Prussia was there a decline in the population during the intercensal period, but the growth in the eastern provinces, occupying the sandy North German plain, was below both the average for Prussia and the average for the German Empire. In the province of East Prussia the rate of increase was only 1.46 per cent. (in the previous five years, however, a decline had been registered); in the province of West Prussia it was 5.01 per cent., in the county of Frankfurt (Brandenburg) 1.93 per cent., in the province of Pomerania 3.02 per cent., and in Posen, Silesia, and Prussian Saxony between 5 and 6 per cent. In Hanover the rate of increase rose again to 6.52 per cent., while in German Jutland (Schleswig-Holstein) it exceeded the average, being 8.38 per cent. Outside of Prussia the population of the two great southern kingdoms, Bavaria and Würtemburg, comprising much of the southwestern highlands as well as the alpine foreland of Germany, rose by 5.45 and 6.03 per cent., respectively, and amounted last December to 8,813,154, while the already densely populated kingdom of Saxony, with 4,502,350 inhabitants, had increased its population by 7.14 per cent. In the Grand Duchy of Baden (2,009,320 inhabitants), bordering the right bank of the upper Rhine, the rate of increase was precisely that of the German Empire—7.52 per cent., while in Hesse and Oldenburg it reached 8.14 and 9.77 per cent., respectively, furnishing another instance of the rapidity with which the population is increasing in western and northwestern Germany. Among the small states bunched together in the highlands of Central Germany, the rate of increase was compara-

tively small—mostly 3, 4 and 5 per cent. It is noticeable that in Alsace-Lorraine, the population of which declined from 1871 to 1885, there has been since the latter date a progressive increase in population, the percentage of growth during the past five years being 5.53 and the actual population last December 1,814,626, or 265,000 more than in 1871. The continued tendency of population to accumulate in large cities is illustrated by the returns for the Hanse towns, the increase in the case of Hamburg (free city and state) being 13.89 per cent., in the case of Bremen 17.14 per cent., and in the case of Lübeck 9.38 per cent. The male population of Germany (29,868,096) is still slightly less than the female population (30,737,087); but, taking the empire as a whole, the proportional increase in the former (7.68 per cent.) has been slightly in excess of the increase in the latter (7.36 per cent.).

SCIENTIFIC NOTES AND NEWS.

Professor Seubert, hitherto the German member of the international committee on atomic weights, has resigned, and Professor Ostwald has been appointed his successor. The committee now consists of F. W. Clarke, United States, chairman; T. E. Thorpe, Great Britain; H. Moissan, France, and W. Ostwald, Germany.

Mrs. W. P. Fleming, curator of astronomical photographs in the Harvard College Observatory, has been elected an honorary member of the Royal Astronomical Society. Mrs. Fleming has also been appointed honorary fellow in the department of astronomy in Wellesley College, in recognition of her distinguished work in astronomy and in gratitude for her helpful cooperation in the establishment of astronomical work in Wellesley College.

Dr. Ch. Wardell Stiles, of the Public Health and Marine Hospital Service, has been elected correspondant étranger of the Société Centrale de Médecine Veterinaire de France.

Professor Edmund Weiss, professor of astronomy in the University of Vienna, has been elected a corresponding member of the Paris Academy of Sciences in the room of the late O. Struve.

Dr. A. Weismann, professor of zoology at Freiburg, celebrated, on July 9, the fiftieth anniversary of his doctorate.

Dr. Adolf Wüllner, professor of physics at Aachen, has celebrated his seventieth birthday.

Professor Conway MacMillan has resigned the chair of botany at the University of Minnesota, and will, it is understood, go into business.

Mr. Edward A. Fath, instructor in astronomy in the University of Illinois, has been appointed fellow in the Lick Observatory.

According to a press despatch from Washington, the commission appointed by the Secretary of the Treasury, the Secretary of Commerce and Labor and the Secretary of Agriculture to formulate rules and regulations for the enforcement of the pure food law, held its first meeting on July 23 at the Department of Agriculture. Dr. H. W. Wiley, chemist of the Department of Agriculture, was elected president, and James L. Gerry, chief of the divisions of customs of the treasury, secretary. It was decided to begin work immediately upon the regulations, and the committee will meet from time to time for consultation as opportunities will be presented. Public hearings will be held, beginning in New York City, on September 17.

A number of his old pupils have indicated their intention to join in the presentation of his portrait to Sir Henry Littlejohn, emeritus professor of forensic medicine in the University of Edinburgh.

The Cambridge Philosophical Society has awarded the Hopkins prize for the period 1897–1900 to Mr. S. S. Hough, F.R.S., chief assistant at the Royal Observatory, Cape of Good Hope, for his work on the dynamical theory of the tides.

The London Chemical Society has awarded its Longstaff medal to Professor W. N. Hartley for his spectroscopical researches.

The Ceylon government has added a hospital to the pathological laboratory which it recently established at Colombo. Both institutions are under the charge of Dr. Castellani.

The states of Maryland and North Carolina will cooperate this summer with the U. S.

Geological Survey in the investigation of the geology of the Atlantic Coastal Plain formations. This work will be done under the direction of Professor W. B. Clark, of the Maryland State Survey.

THE geology of the Wilmington, Phœnixville and Honey Brook quadrangles in southeastern Pennsylvania will be mapped this summer by Miss Florence Bascom, assistant geologist of the U. S. Geological Survey and associate professor in Bryn Mawr College. She will complete the survey of the crystallines of the Wilmington and Phœnixville quadrangles and make a preliminary survey of the Honey Brook quadrangle, with a view to gaining further light on the problem of the Piedmont gneisses.

AREAL and economic surveys in Georgia, North Carolina, South Carolina and Tennessee will be made this summer by Mr. Arthur Keith, geologist, of the U. S. Geological Survey, assisted by Mr. D. B. Sterrett.

MR. WILLIAM L. FINLEY met with a somewhat serious accident by the fall of his horse while he was engaged in photographing bald eagle and osprey nests on San Clamente Island.

MR. E. G. WOODRUFF, instructor in mineralogy at the Oklahoma State University, has been granted a year's leave of absence to study at Harvard, where he has secured a scholarship.

MR. JOHN G. HALL, assistant in the Harvard department of botany, has been elected to the position of assistant in plant pathology in the North Carolina Agricultural Experiment Station.

AT the general meeting of the British Institute of Hygiene, held last week, Sir William Broadbent was elected president and Sir William Bennett, Surgeon-General Cleghorn, Sir Alfred Cooper, Mr. Mayo Robinson and Professor Sims Woodhead were elected as vice-presidents of the association.

DR. PAUL DRUDE, who last year went to Berlin as professor of physics and director of the physical laboratory, died by suicide on July 5, at the age of forty-two years. Dr. Drude was editor of the *Annalen der Physik* and was eminent for his theoretical and experimental researches on the electromagnetic theory of light.

THE death is announced of Dr. Joseph Körösy, director of the Statistical Bureau at Buda Pesth and the author of important studies on demography.

THE death is announced of Dr. George W. Atherton, since 1882 president of the Pennsylvania State College. He was born in Massachusetts in 1837, and graduated from Yale University in 1863.

THE U. S. Civil Service Commission announces an examination, on August 29–30, to secure eligibles from which to make certification to fill at least ten vacancies in the position of assistant engineer, at salaries of $1,400 to $1,600 per annum and two or more at a salary of $1,800 per annum each, in the Philippine Service, and similar vacancies as they may occur in that service.

THE French Association for the Advancement of Science is holding its thirty-fifth meeting at Lyons this week, under the presidency of M. Gabriel Lippmann.

AN International Congress on Polar Exploration will meet at Brussels, beginning on September 7. Further information may be obtained from M. Lecointe, director of the Brussels Observatory.

THE International Committee on Aeronautics, of which M. Hergesell is president, will hold its fifth biennial congress at Milan at the beginning of September. M. Palazzo, director of the Italian Meteorological Service, will be the president of the congress.

THE seventh annual meeting of the American Conference of Pharmaceutical Faculties will meet at Indianapolis, Ind., on September 5 at 3 P.M., under the presidency of Dr. Henry M. Whelpley, of St. Louis.

BY action of the legislature of Indiana, the Indiana University has been given the management of the Donaldson farm, a tract of one hundred and eighty-two acres of timber land, on which are the openings to extensive caves and to the richest blind-fish localities

known. For the full year from September 1, 1906, to September 1, 1907, the university offers a fellowship to the value of $500 to a graduate student desiring and able to conduct research work with cave animals. He must reside on the farm. The university has erected a two-roomed shack, 15 x 30 feet, which serves temporarily as sleeping quarters and laboratory. The place is equipped with beds, kitchen and dining-room furniture, aquaria, microscope, etc. Applications and letters of enquiry should be addressed to C. H. Eigenmann, Winona Lake, Indiana.

UNIVERSITY AND EDUCATIONAL NEWS.

The sum of $50,000 has been given to Yale University by Mr. Edwin Milner, of Plainfield, Conn. The interest on the money is to be used to educate some resident of Plainfield.

The State College of Physicians and Surgeons of Indianapolis, Indiana, has entered into an affiliation for educational purposes with Indiana University. By terms of the affiliation the first two years of the state college will be given in the laboratories of Indiana University, in the medical department of which the first two years of medicine have been given for several years. The last two years of the course will be given at Indianapolis, where a new hospital with a capacity of one hundred beds has been organized under the direct control of the state college, which will be used for clinical teaching. This will make it possible for students to follow cases throughout the entire course of the disease and assist in after-treatment of surgical cases. Graduates of the school will receive their medical degree and diploma from Indiana University.

King Edward has approved the appointment of a Royal Commission for the purpose of holding an enquiry into Trinity College, Dublin, and the University of Dublin. The commission will consist of Sir Edward Fry (chairman), the Chief Baron of the Exchequer, Ireland, Sir T. Raleigh, Sir A. W. Rücker, Dr. H. Jackson, Dr. Douglas Hyde, Professor D. J. Coffey and Mr. S. B. Kelleher.

The following promotions and appointments have been made at Brown University: Associate Professor Alexander Meiklejohn, dean of the university, to become professor of logic and metaphysics; Assistant Professor W. H. Kenerson, to become associate professor of mechanical engineering; Assistant Professor A. H. Blanchard, to become associate professor of civil engineering; Assistant Professor H. P. Manning, to become associate professor of mathematics; T. M. Phetteplace, to become assistant professor of mechanical engineering; C. W. Brown, to become assistant professor of geology; F. S. Beattie, to become assistant in chemistry; M. L. Dolt, to become assistant in chemistry; H. E. Chandler, to become assistant in civil engineering; and Miss Alice W. Wilcox, to become instructor in biology and household economics at the Women's College.

At Lehigh University the following nominations and appointments have been announced: P. A. Lambert and Arthur E. Meake have been advanced from assistant professorships to full professorships in mathematics; John H. Ogburn from an instructorship to an assistant professorship in mathematics and astronomy; John Duer Irving from an assistant professorship to a full professorship in geology; Barry MacNutt from an instructorship to an assistant professorship in physics.

Mr. E. B. Hart, associate chemist of the New York Agricultural Experiment Station, has been chosen professor of agricultural chemistry and chemist of the Experiment Station of the University of Wisconsin.

Mr. Chas T. Kirk, A.M. (Oklahoma, '05), was recently elected assistant professor of geology at the Montana School of Mines, Butte, Montana.

The Alice Freeman Palmer fellowship at Wellesley College has been awarded to Miss Anna Johnson, B.A. (South Dakota), M.S. (Iowa), A.M. and Ph.D. (Radcliffe), a student in mathematics.

Dr. Max Le Blanc, professor of physical chemistry at Karlsruhe, has been called to the chair at Leipzig, vacant by the retirement of Professor Wilhelm Ostwald.